OIL & FAT INDUSTRIES

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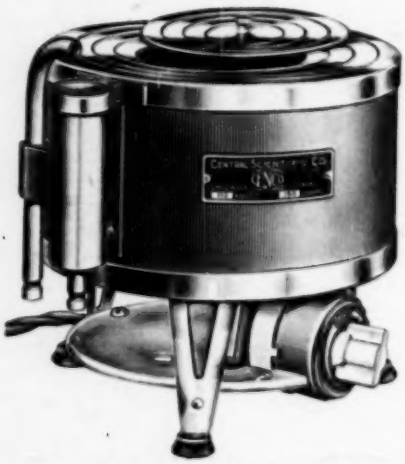
A Small Electrically Heated Water Bath



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Volume of water	1100 cc
Total volume of container	2000 cc
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Switch point	A	B on 110 volts	B on 220 volts
low	80° C	63° C	80° C
medium	boiling	85° C	boiling
high	rapid boiling	boiling	rapid boiling

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Rendering Plant Cuts Labor to Two Men by Conveyers

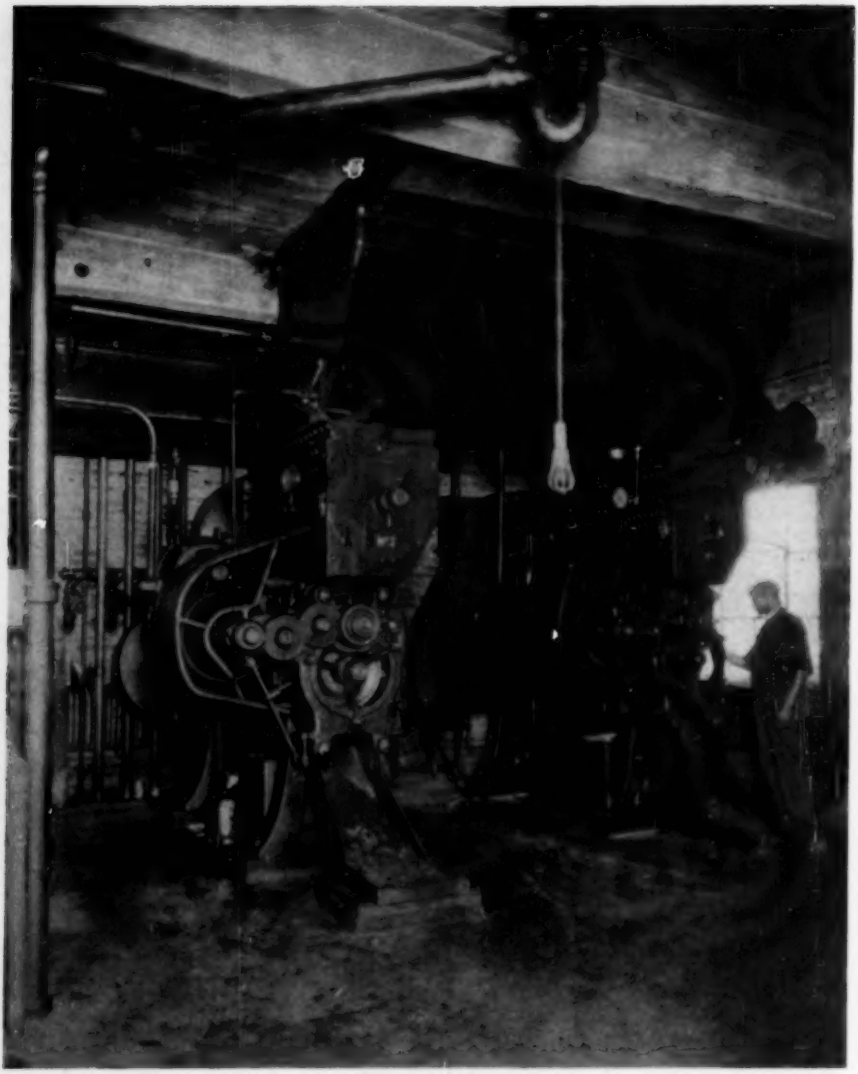
How Milwaukee Retail Tallow and Calf Skin Association Renders Its Own Waste and Clears a Nice Profit

By L. G. DROEGER

The cookers. Meat scraps are cooked here until 80 per cent of the fat has been removed and drained. The residue is then drawn off and carried away by the spiral conveyer on the floor.

A PROFITABLE arrangement for the extraction of oil and fat from the waste gathered at retail meat markets is in operation at the plant of the Retail Tallow and Calf Skin Association at Milwaukee, Wisconsin. The plant is one of unusual interest; not only because of the high degree of efficiency it represents, as a result of which many have visited it from all over the United States for the purpose of studying its operation; but also by reason of the fact that no engineers were consulted in its design.

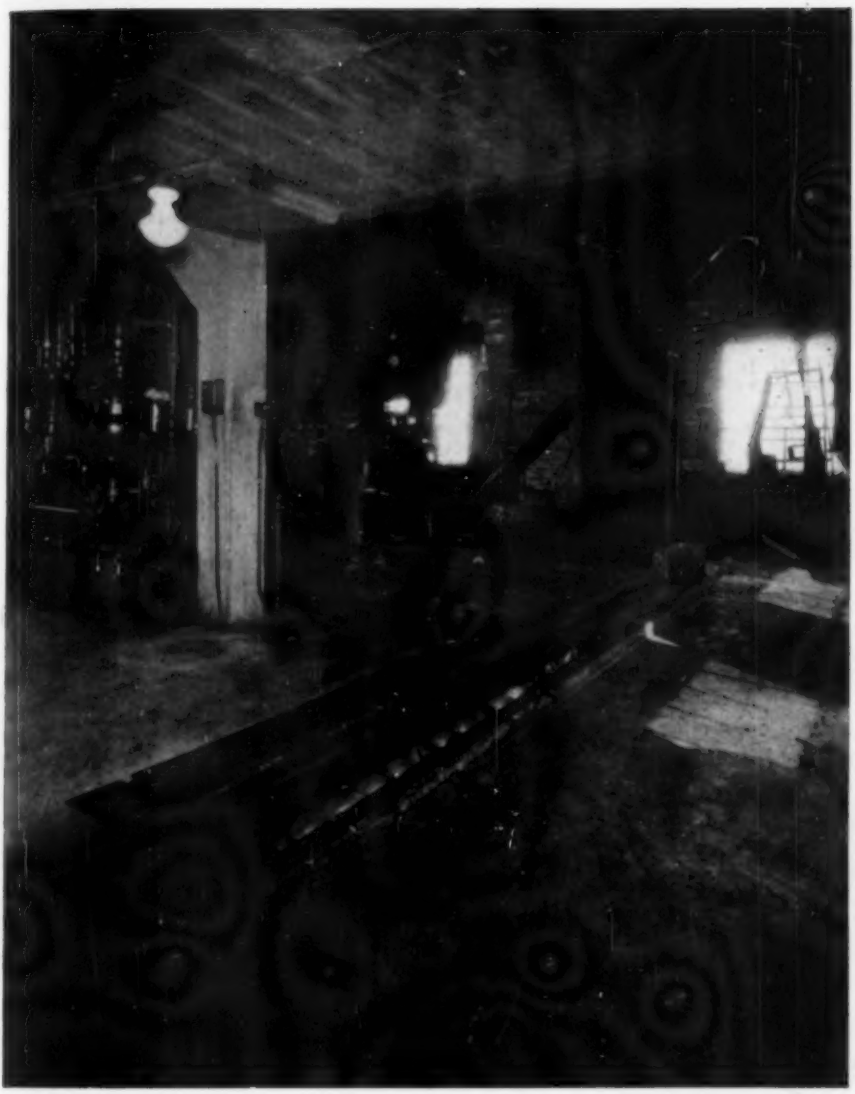
The Retail Tallow and Calf Skin Association is composed of retail market owners in Milwaukee. Formerly they disposed of their waste materials to rendering plants owned and operated by outside interests. And as is frequently the case of "independent" rendering plants, they sometimes become too independent. Such, indeed was the



The residue from the cookers is run through crushers and the remaining 20 per cent fat removed. The fat goes to storage tanks and the meat drops down into containers to be sacked as feed.

case here. These people simply would not pay the retail market owners what the latter considered was a fair price for this waste.

All this was before the Retail Tallow and Calf Skin Association existed as such. One day the retailers got worked up to a point where they felt something ought to be done, and that was how the Association came to be formed. As stated, the plant was designed



The Rex spiral conveyor leading to the elevator. Residue from the cookers is carried up to floor above.

without outside assistance. The project was financed in one of the simplest and most economical ways by which any rendering plant has ever been put up. Members are now getting more for their product than formerly. And what gives them the most satisfaction, they can always feel sure of a market for their waste at the time they wish to dispose of it.

The operating plan is simplicity itself, and its chief charactertistic is the way in which automatic con-

Showing head of the elevator which carries residue from the cookers (Fig. 1) to the crushers (Fig. 4). The belt conveyor is magnetized and takes all metal from the residue. This residue is then dumped down a chute into a storage bin above the crushers.

veying equipment has been utilized so as to reduce labor to a minimum. Indeed, all the rendering in the entire plant is done by two men; whereas most establishments of the same size require six on an average. The Association pays a gracious compliment to the Chain Belt Company of Milwaukee, manufacturers of the Rex conveying equipment installed here, and attributes the success achieved largely to this equipment.

The raw material, which includes bones and scrap meat ends, is taken to the top floor of the plant and is started on its course from there. Four high pressure vacuum cookers break down the bone and meat structure and loosen the fat content. After the material is thoroughly cooked it goes into percolators. The free fat is allowed to drain and is pumped to a settling tank on the floor above.

The remaining scrap, which still contains a large amount of oil, is charged into a Rex spiral conveyor directly under the cookers. The conveyor running the length of the floor carries the material to a Rex bucket elevator into which it feeds. The elevator raises the material to the floor above and discharges directly onto a metallic separator. The small parts of metal, such as nails and staples, are then removed by this piece of machinery, which consists of a belt conveyor running over a magnetized pulley. All particles of metal cling to the belt until they pass the dead center of

the pulley, and then fall into a pan below. From here the free material drops into a measuring hopper above the expellors. A right and left worm conveyor deliver it respectively into these two machines, which press out all but 7 per cent of the remaining fat.

The pressed substance, which is now quite dry, is blown by a pneumatic conveyor to the top floor. It is then ground and dropped to the first floor where it is weighed and sacked for shipment. This product is sold for protein content and there are many formulas for its use. It can be used as chicken or hog feed, and when mixed is an excellent fertilizer.

The oil is taken from the settling tank weighed and stored in four large vats on the first floor ready for shipment. The tank room is constantly kept heated in order that the oil may be pumped at any time into the waiting cars. The greater percentage of this product is sold for the making of soap.

A Correction

In the January issue of OIL AND FAT INDUSTRIES, a typographical error occurs in the article "Copra Sampling, Inspection and Analysis," by P. W. Tompkins, Curtis & Tompkins, San Francisco. In the first line of the second column, page 23, the word "rely" is written "reply." Because this error destroys the meaning of the sentence, we are most anxious to comply with the author's request for a correction. The paragraph should read:

"The character of cocoanut oil obtained must necessarily reflect the quality or grade of copra from which it was derived and while some crushers have their own buyers on the spot to aid them in their selection, others rely on inspection at points of entry."

Detergents Committee to Meet in Washington April 9

A meeting of the Detergents Committee of the A. O. C. S. will be held on Saturday, April 9 in Room 214 of the Chemistry Building, Bureau of Standards, Washington, D. C. Results of collaborative work and plans for future work on the evaluation of detergents will be discussed.

Dr. Eisenstein Visiting Here

Dr. Alfred Eisenstein, the well known authority on oils and fats, of Vienna, Austria, is spending a few weeks with Arthur D. Little, Inc., consulting chemists and engineers of Cambridge, Mass., with whom he is associated as European correspondent and consultant.

Chemistry Courses Announced

The University of Michigan announces a new bulletin describing courses in chemical engineering which offer opportunities and facilities for special study along this line. The bulletin also contains a prospectus of the Department of Chemistry, which offers advanced courses in colloid and organic chemistry.

Starts Up New Procter & Gamble Crisco Factory

C. B. Cluff, Procter & Gamble Company, Ivorydale, Ohio, has been spending the past month at the Staten Island, New York, plant of his company, starting up a new "Crisco" factory. The Staten Island works also have a complete, new hydrogenation plant and a complete, new oil refinery to operate in connection with the Crisco factory. Mr Cluff is stoping at the Robert Treat in Newark, N. J., and is accompanied by Mrs. Cluff.

Manila Cocoanut Oil: Color and Fluorescence

By P. W. TOMPKINS
Curtis & Tompkins, San Francisco

WHEN the tariff of 1922 went into effect cocoanut oil importations of the types commonly known as Tahiti, Java and Japanese, automatically ceased and the so-called Manila oil became our only outside supply. Before that time, these four grades were well known market products differing widely in their color ranges, though not greatly in their acid contents.

The difference then was more directly due to copra grades[1] from which the oil was derived and was little affected by factory controlled methods. The environments, climatic conditions and customs of native handling still predominate over all else in giving the copra from any locality its distinctive character, but improved conditions of manufacture have brought a change in the oil.

Manila oil prior to 1921 was produced by numerous mills, small and large and of greater or less efficiency, and in consequence the output was variable, particularly as to the color[2]. At present, however, there are about seven mills producing, all more up to date in their methods of handling the oil. The color is better and more uniform as a result of blending operations and occasional decolorizing. While in the past it was not uncommon to receive shipments of very dark oil, this is no longer encountered. This change for the better is most strikingly illustrated by the following survey of shipments entering the port of San Francisco since the beginning of 1919; those during 1919 were largely case and barrel goods, and also during the early part of 1920 considerable was received in packages, but from then on practically all shipments have arrived in bulk.

An extreme example of the manner in which oil is characterized by the copra from which it is derived, may be cited in the following record of a shipment from a locality ordinarily yielding dark colored oil. The oil from this copra was highly fluorescent with a color of 150 yellow and 35 red before refining, 100 yellow and 10 red after refining and 30 yellow and 4.7 red after bleaching, yet it was pressed from material wholly free from any contamination and only reflects a condition inherent to

COLOR & ACID COMPARISONS OF EIGHT YEARS
SHIPMENTS OF MANILA COCOANUT OIL

		1919	1920	1921	1922	1923	1924	1925	1926
Lovibond Color Readings:									
Minimum...	Yellow...	35	35	50	20	20	30	30	30
	Red.....	4.6	6.2	5.4	3.2	3.4	5.0	4.2	4.2
Maximum...	Yellow...	120	130	130	120	50	50	50	50
	Red.....	21.7	21.0	50.0	21.5	8.1	9.0	8.4	8.7
Average.....	Yellow...	60	60	90	55	40	40	30	35
	Red.....	10.7	10.2	15.1	7.9	6.4	6.5	5.8	5.9
Per Cent Free Fatty Acids (As Oleic)									
	Minimum.	2.62	2.32	1.85	1.83	1.65	1.30	2.08	2.48
	Maximum.	6.99	6.48	4.70	4.65	3.95	3.95	5.70	5.65
	Average..	4.98	4.11	3.14	3.12	3.12	2.54	3.22	3.74

the product and influenced by its curing, age and exposure. The character of the oil could easily have been mistaken as a condition brought about by marked fuel oil contamination.

A natural inference is to be drawn from the above example, namely, that when very dark oils in their crude state are decolorized (not refined), it may reduce the color to the desired point for shipment, but at the same time be found unsatisfactory when the oil is later subjected to the customary refining and bleaching process here. In such cases the oil does not respond to refining as expected and the color in consequence is but slightly changed, as the original bleaching has lowered the color about as far as it will go, and the oil in its final treatment here, does not reach the low point desired.

It therefore follows that some few crude oils while received with satisfactory color, due to more modern methods, may sometimes not be any more desirable as a result of it, as they will not much further reduce in color, or at least not to the desired point. However, such cases as these are very rare and the majority of Manila oils now received are a great improvement over the older shipments.

Fluorescence

With dark colored oils, the consideration of the cause of fluorescence arises and the possibility of fuel oil contamination. Of the large number of copra shipments examined, sundried, smokedried and mixed, and from numerous points of origin, we have yet to find a single shipment which does not show fluorescence in the pressed oil, persisting even after refining and bleaching, although considerably diminished after bleaching but sometimes even more pronounced after refining.

When this phenomenon is observed under proper and uniform conditions and with a full knowledge of the copra situation, it affords a fairly reliable means of establishing abnormal fluorescence due to fuel oil contamination. The essential factor in making deductions, with reasonable assurance however, lies in the fundamental knowledge of the type cocoanut oil under consideration, and the effect fuel oil has on the particular refined and bleached oil.

By carefully controlled observation, it is possible to reach correct and equitable decision when the extent of fuel oil contamination is of practical significance, but not when only a trace is present, as an indefinite margin overlaps between the normal and abnormal fluorescence, and in such cases no decision can be reached.

Details of this subject are referred to in previous articles[3], also the phenomenon as it applies to Chinese Cottonseed oil[4]. A further article by L. E. Fisher of Shanghai treats fluorescence as it relates to both Chinese and Indian Cottonseed Oil[5].

Reference to the subject of natural fluorescence in vegetable oils would not be complete without quoting in part references to the subject found in Bureau of Chemistry, circular 84, U. S. Department of Agriculture, by Walker & Broughton, published in 1911, in substance as follows:

"Fluorescence in an oil does not, however, prove the presence of mineral or rosin oil. A number of samples of other fatty oils (other than linseed oil), of known purity, some of which were cold-pressed from the seed in the Bureau of Chemistry, showed marked fluorescence, in some cases as marked as that of many pure mineral oils. It appears, therefore, that while it is interesting to know that the enclosed arc

is a very convenient means of strongly magnifying fluorescence, this fluorescence is not proof of the presence of mineral or rosin oil."

[1] Cotton Oil Press, Feb., 1920—"Cocoanut Oil and It's Ally," Vol. 3, No. 10, P. 40. Also Journal of the Oil & Fat Industries, Jan., 1927, Vol. 4, No. 1, P. 23.
[2] Cotton Oil Press, Nov., 1922—"Variations in Color Readings of Cocoanut Oil," Vol. 6, No. 7, P. 30.
[3] Cotton Oil Press, March, 1924—"Detection of Small Amounts of Fuel Oil in Cocoanut Oil," Vol. 7, No. 2, P. 33.
[4] Cotton Oil Press, June, 1921—"Fluorescence in Chinese Cottonseed Oil," Vol. 5, No. 2, P. 123.
[5] Cotton Oil Press, April, 1922—"Fluorescence in Chinese Cottonseed Oil," Vol. 5, No. 12, P. 36.

Pilchard Oil from Canada

The motorship *Dinteldyk* recently left Vancouver with a cargo of 625 tons of pilchard oil destined for Europe and thus inaugurated the shipping of a new British Columbia product to European markets. Converting fish into oil and meal has become an important industry on the west coast of Vancouver Island, British Columbia. This year fifteen plants are operating, ten more than last year. Two million dollars have been invested in the business and during the last few months $700,000 have been invested for new machinery for the older plants. The aggregate capacity of these plants is more than six times as great as last season, which was the first year of the industry. The first run of the pilchards commenced in June and lasted until about the end of October. If the run of these fish comes up to expectations, the value of the year's production should be in the neighborhood of $2,000,000.

Joins Staff of Arthur D. Little

C. L. McArthur, formerly Chief Technologist for the F. X. Baumert Co. Inc., cheese manufacturers, has joined the staff of Arthur D. Little, Inc., chemists, engineers and managers of Cambridge, Mass. Mr. McArthur spent several years in the capacity of research bacteriologist for the government and was at one time head of the Department of Bacteriology of the University of Akansas.

Cottonseed Crushings Increase In Seven Months' Period

Cottonseed crushed in the seven-month period, August 1 to February 28, totaled 4,951,671 tons, compared with 4,478,441 tons for the same period a year ago, and cottonseed on hand at mills February 28 totaled 818,528 tons, compared with 744,246 tons a year ago, the census bureau announced to-day.

Cottonseed products manufactured in the period and on hand February 28 were:

Crude oil produced, 1,471,752,045 pounds, compared with 1,288,592,633, and on hand, 155,680,433 pounds, compared with 121,579,275.

Refined oil produced 1,180,701,015 pounds, compared with 1,000,507,205, and on hand 460,721,631 pounds, compared with 260,451,744.

Cake and meal produced 2,218,245 tons, compared with 2,081,965, and on hand 153,639 tons, compared with 357,495.

Linters produced 806,087 bales compared with 839,708, and on hand, 194,336 bales, compared with 200,105.

Exports of linters in the period totaled 134,518 bales, compared with 59,569.

Final 1926 Ginnings Show Big Decline

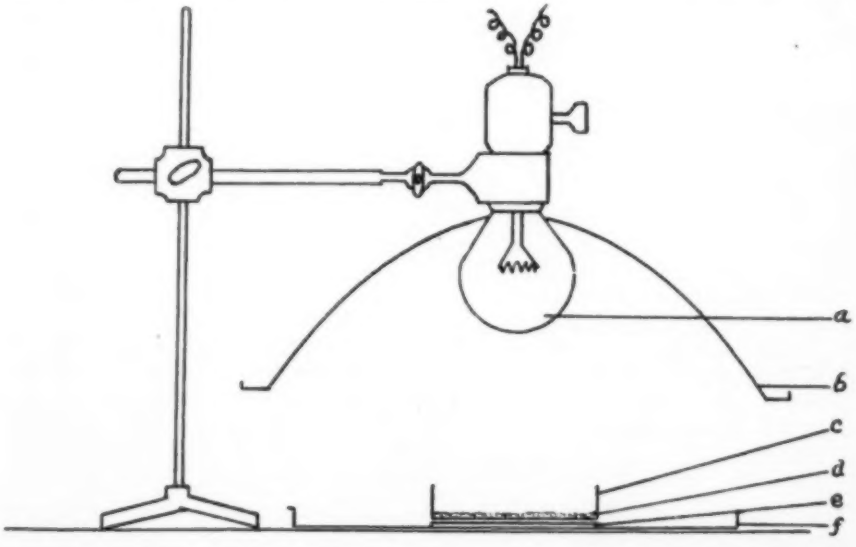
The report of the U. S. Census Bureau on cotton ginnings for 1926, issued on March 21, surprised everyone by showing a decline of some 700,000 bales below the government December estimate.

A New Method for the Rapid Determination of Moisture

By T. L. RETTGER
The Buckeye Cotton Oil Co.

THE accurate determination of moisture in cottonseed meal and related products, while apparently simple, has offered great difficulty to the chemists of the industry. Through the thorough study and subsequent standardization of other analytical methods there has been achieved a degree of accuracy which is truly remarkable. But the determination of moisture has stubbornly withstood all similar efforts to arrive at a procedure of analysis which would give comparably accurate results. The analysis for moisture is accepted as an approximation only.

The two methods for moisture determination in use are (1) oven drying to constant weight and (2) distillation and condensation of the moisture. The first method is simple and the most dependable, although quite frequently there are changes in the weight of the sample in addition to moisture loss. A minimum of two hours is required. The second method is quicker but is less reliable and usu-



A. 50 W. Clear Lamp
B. Auto Reflector
C. Moisture Dish
D. Layer of Sample
E. Asbestos Mat
F. Tin Plate

ally requires fragile apparatus and considerable manipulation.

In the method given below a thin layer of the sample is exposed to light and heat. The absorption of light energy produces heat effect and the rapid liberation of the moisture present. The advantages are simplicity of apparatus and procedure, and particularly the much shorter time required. The short time of heating, about fifteen minutes, minimizes the change in weight due to chemical change in the sample. Results agree with those obtained by other methods on cottonseed meal, hull bran, and corn meal. While experiments with the method have been confined to these substances, it is probable that accurate results may be obtained on other materials that may be finely ground. The principle involved may be applied in designing apparatus which will make a number of determinations simultaneously.

Material Required: One support, clamp holder, and clamp.

One extension cord and lamp socket.

One 50W clear Mill Type lamp.

One automobile headlight reflector.

One 9 inch tin pie plate.

One 3 inch circle asbestos.

One thermometer.

Aluminum moisture dishes, di. 90mm., ht. 15 mm.

Analytical Balance.

Assembly: Enlarge the hole in the center of the reflector so that the lamp can be screwed into the socket through the hole. Drill four ¼ inch holes on a three inch circle around this hole for ventilation. Place the tin plate on a table with the asbestos mat in the center. Support the lamp and reflector directly over it, with the rim of the reflector about two inches from the level of the table. See the illustration.

Adjustment: Spread several grams of the material to be analysed in the lid of a moisture dish and place on the asbestos below the lamp. Rest the bulb of the thermometer in the sample and after ten minutes adjust the height of the reflector so that the temperature will be constant at 115°C. ± 5°. The apparatus is now ready for use.

Analytical Procedure. Weigh 5 grams of the ground sample into a tared moisture dish. Spread the sample over the bottom of the dish in a thin even layer and place on the asbestos mat below the lamp. Expose for fifteen minutes. Replace the lid, cool and weigh. The time given is the maximum, and may be reduced on some materials.

COMPARATIVE RESULTS—MOISTURE

Cottonseed Meal

Brown-Duvel	Electric Oven	Lamp Method
6.2	6.3	6.4
5.8	6.3	6.4
		6.4

Cottonseed Hull Bran

Brown-Duvel	Electric Oven	Lamp Method
10.9	11.2	10.8
11.1	11.2	11.0
		11.0

Corn Meal

Brown-Duvel	Electric Oven	Lamp Method
12.0	12.5	12.4
12.0	12.7	12.5
		12.5

Alkali Absorption in Crude Oil Refining

By DAVID WESSON

IN 1899 the writer made some experiments with a view of determining the amount of caustic soda taken up by oils in the process of refining. Experiments were made by adding a definite excess of caustic soda in the form of lye of different strengths to an oil, stirring the oil by hand from time to time, and titrating the excess of caustic soda in the same manner as in determining the free fatty acids. While the method was crude, the results showed that absorption increased with the strength of the lye and also with the temperature. There was an initial absorption greater than that due to the free fatty acids, after which the absorption slowed down, and when the results were plotted in curves the subsequent increase was very slow.

In 1917 the investigation was taken up again with the idea of testing the method under improved conditions.

Apparatus: The apparatus employed was a cylindrical can about 5½ inches in diameter, 10 inches deep, surrounded with a water-jacket and provided with a stirring apparatus worked by an electric motor. Temperatures were controlled by means of a thermometer in the oil and another one in the water-jacket.

Two burettes, 10 or 20 cc. capacity, divided into tenths, preferably those with a very small bore so as to give a long scale. These burettes should be arranged to fill quickly from reagent bottles; those designed by the writer for fatty acid determination are the most convenient.

One Pipette, graduated to deliver 10 grams of crude oil at 20°C.

Some 4-oz. oil sample bottles.

Reagents: Quarter normal HC1. Quarter normal NaOH.

Phenolphthalein solution for indicator. (1 in 100 alcohol.)

Re-distilled denatured alcohol or grain alcohol.

The phenolphthalein solution and the alcohol should be made neutral before using.

Process: About 2,000 grams of oil were weighed into the apparatus and the stirrer started. The temperature was then brought to the desired point for the experiment. Carefully weighed caustic soda of a calculated amount was run in and the time noted. At intervals of 5 or 10 minutes 10 grams of oil and alkali were withdrawn by the pipette and titrated in 4 ounce bottles in the same manner as the titration of fatty acids, using phenolphthalein as an indicator and neutralized re-distilled denatured alcohol as liquid. Titration was first made on the acid side with quarter normal HC1. When there was any doubt about the end point, quarter normal NaOH was added to akalinity and the solution again titrated to the acid side. By having the two burettes side by side it was possible to obtain end points within .1 cc. without any difficulty.

Very Important: After each addition of the acid or alkali the bottles should be corked and shaken very violently in order to get the correct end point. It is also advisable to let bottles stand one-half minute or so when near the end point so as to observe the color in the supernatant alcohol. There

TABLE I

Sp. Gr. Lye.....	1.092	1.117	1.117	1.18
P. C. NaOH in Yye.....	8.19	10.18	10.18	17.
P. C. Lye in Oil.....	6.26	5.	5.	3.22
P. C. NaOH in Oil.....	.510	.509	.509	.548
P. C. NaOH in Mix....	.472	.485	.485	.534

Start Time Min.	Temp. Deg.	NaOH Abs.	Temp. Deg.	Abs.	Temp. Deg.	Abs.	Temp. Deg.	Abs.
0	21.3						20.3	
5	21.4	.256			30	.262	21.5	.230
10	21.7	.268	21	.252	30	.278	21.8	.255
20	21.7	.286	21	.276	30	.304	21.6	.286
30	*21.6	.300		.304	30	†.330	21.5	.311
40	21.6			.331	30	.362	21.3	.353
50	21.6	.326		‡.340	30	**.394	21.3	.378
60	§21.5	.352		.379			21.3	¶.405
70								.434
80							21.3	.445
90							30	
100							50	.491
120							60	‖.522

* Breaking fast. † Break started. ‡ Breaking in large flakes. ** Large grain. § Fully broken. ¶ Pinhead break. ‖ Good open break ready to settle.

TABLE II

Table Showing Rate of Absorption of NaOH by Prime Crude at Different Temperatures

Analysis of Oil		
F.F.A.	1.06	1.06
NaOH for F.F.A.	.15	.15
NaOH for Color, etc.	.50	.50
NaOH Used	.50	.50
NaOH Absorbed (analytically)..	.335	.335
NaOH Used in Excess	.165	.165
Sp. Gr. of Lye	1.116	1.116

Absorption at 21° C.		Absorption at 30° C.	
Minutes	Absorbed	Minutes	Absorbed
0	0	0	0
10	.252	5	.262
20	.276	10	.278
30	.304	20	.304
40	.331	30	.330
50	.346	40	.362
60	.379	50	.394

has been noted in titration at times a tendency of particles insoluble in alcohol to retain alkalinity, which is only removed by a thorough shaking.

Calculation of Results: In calculating the amount of caustic soda absorbed by the oil we have to take into consideration that the portion titrated represents the oil plus the added lye. For instance; if we use 5 per cent of lye containing say 10 per cent of caustic soda, we would add .50 per cent NaOH to the oil we start with, but the mixture of lye and oil would amount to 105 grams of material for each 100 grams of oil started with, and the results of our titration would show the amount of caustic in the 105 grams of mixture. It is evident, therefore, that the mixture contains

$$.50\%\ \text{NaOH} \times \frac{100}{105} = 95.2\% \times .50\% = .476\%$$

which is the percentage of NaOH in the mixture. Each centimeter of quarter normal HCl equals .01 NaOH which on the weight taken is .10 per cent NaOH. If we subtract the quantity of caustic as shown by the burette reading from .476 we have the percentage of caustic absorbed in the mixture. As the mixture contains only 95.2 per cent of oil, we must divide this result by 95.2 in order to get the percentage of caustic absorbed by the oil.

Results

The method was tested out carefully on a sample of prime crude taken from refining No. 440, Bayonne, consisting of a mixture of oil from Charlotte and Chester, which analyzed as follows:

Absolute Oil	97.65
Absolute Loss	2.35
Loss not Fat	.97
F.A. as Soap	1.38
F.F.A.	1.06
F.A. as Soap — F.F.A. = Excess F. A. Saponified	.32
NaOH Absorbed	.335
NaOH for F.A. as Soap	.192
F.A. for Organic Matter	.143
NaOH for Organic Matter and F.F.A.	.293
NaOH for F.A. as Soap over F.F.A.	.042

Three strengths of lye, approximating 8 per cent, 10 per cent and 16 per cent NaOH were used, and obtained results shown in Table I.

Discussion of Results

On consulting Curve No. 1 it will be noticed that the fatty acids are neutralized practically instantaneously after the addition of the caustic soda. It will also be noticed that reaction slows down after the first 10 minutes and then proceeds gradually. It was noticed in the operation of the kettles that when NaOH amounting to that shown by the Absolute Test had been absorbed that the oil commenced to break and not until then. In the case of the strong lye, the break was very slow and did not occur until after the temperature had been raised. In the case of the weaker lyes the absorption and break were both quicker at the higher temperature than at the lower.

In looking into the caustic absorption further it would appear from the analysis of the oil that the caustic taken up in refining forms three functions: First, combination with the fatty acids: Second, combination with organic matter not fat: Third, breaking down an organic complex containing fatty acids and forming a small quantity of soap.

In each case it will be noted that there was a gradual rise in the

curve after the necessary amount of NaOH had been absorbed, and soap was constantly formed as long as the operation proceeded. It will also be noted that at the higher temperature the saponification is more rapid, also that the stronger alkali saponifies more oil.

Chart No. 2 shows the results of two experiments on the same oil.

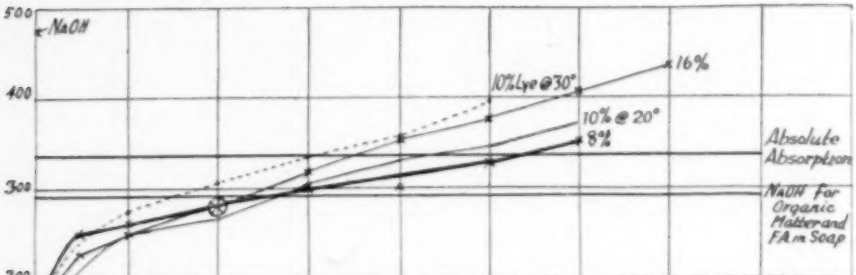


Chart No. 1

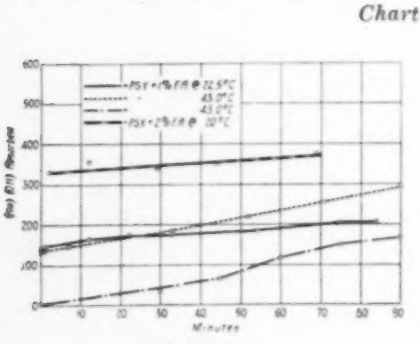


Chart No. 4

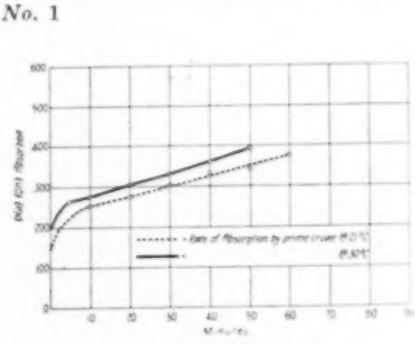


Chart No. 2

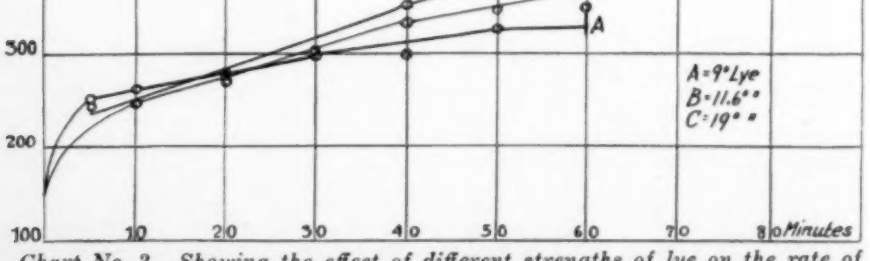


Chart No. 3. Showing the effect of different strengths of lye on the rate of absorption at 21° C.

for the purpose of showing the effect of temperature. The data are given in Table No. II.

The Curves start at the points of the first titration, it being assumed that the NaOH is neutralized at once. It is quite evident that 10°C. speeds up the reaction and saponifies more oil.

In the oil under consideration we note that the Absolute Absorption of F.A. was	.335
F.A. as Soap by Absolute Method was	1.38
Requiring NaOH	.192
Required for combining with organic matter	.143
The F.F.A. in the oil was.....	1.06
Requiring NaOH for neutralization	.150
This added to the NaOH for neutralizing the organic matter gives us	.293
If we subtract this .293 from the total Absolute Absorption we find NaOH	.042
Required for combining with F.A. to make soap.	

It is quite evident, therefore, that any caustic used in excess of the above amounts is going to be used in saponifying oil.

Chart No. 3: This chart was plotted from data below, and shows the effect of strength of lye on absorption. It will be noted that the stronger the lye, the greater the absorption or saponification.

Alkali Absorption of Refined Oil

Experiments were made on Prime Summer Yellow Oil to note the effect of, 1st — Time; 2nd — Temperature; and 3rd—Effect of Free Acid.

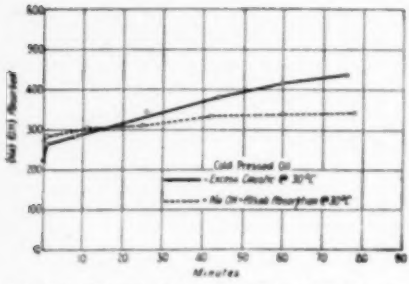
Experiment No. 1: The oil was stirred at 23° for 80 minutes without absorption taking place. The temperature was quickly raised to 40° and then a curve plotted shown as C on Chart. The details of the experiment are given in the table headed Experiment No. 1.

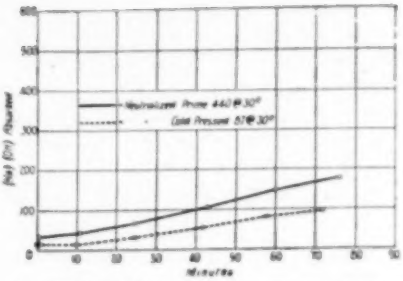
The lye used was 9° and enough

Tabulation Showing Effect of Strength of Lye on Rate of Absorption

	9° Lye	11.6° Lye	19° Lye
F.F.A.	1.06	1.06	1.06
NaOH for F.F.A.	.15	.15	.15
NaOH for Color, etc....	.36	.35	.40
NaOH Used	.51	.50	.55
NaOH Abs. (analyt.)..	.335	.335	.335
NaOH in Excess	.175	.165	.215
Sp. Gr. Lye	1.092	1.116	1.190

Min.	Abs.	Temp. Deg.	Min.	Abs.	Temp. Deg.	Min.	Abs.	Temp. Deg.
0	0	21.3	0	0	21.1	0	0	20.3
5	.256	21.4	10	.252	21.1	5	.250	21.5
10	.268	21.7	20	.276	21.1	10	.255	21.8
20	.286	21.7	30	.304	21.1	20	.286	21.6
30	.300	21.6	40	.331	21.1	30	.311	21.5
40	.300	21.6	50	.346	21.1	40	.365	21.3
50	.326	21.6	60	.379		50	.378	21.3
60	.352	21.5				60	.405	21.3
						70	.434	21.3
						80	.445	21.3





(Left) Chart No. 5. (Right) Chart No. 6. This shows differences in results on neutralized Prime Cottonseed Oil and neutralized Cold Pressed Oil. The oils were simply neutralized for removing the free fatty acid. This experiment would seem to indicate that the Lipoids and other matters in regular Crude Oil tend to increase its rapidity of saponification.

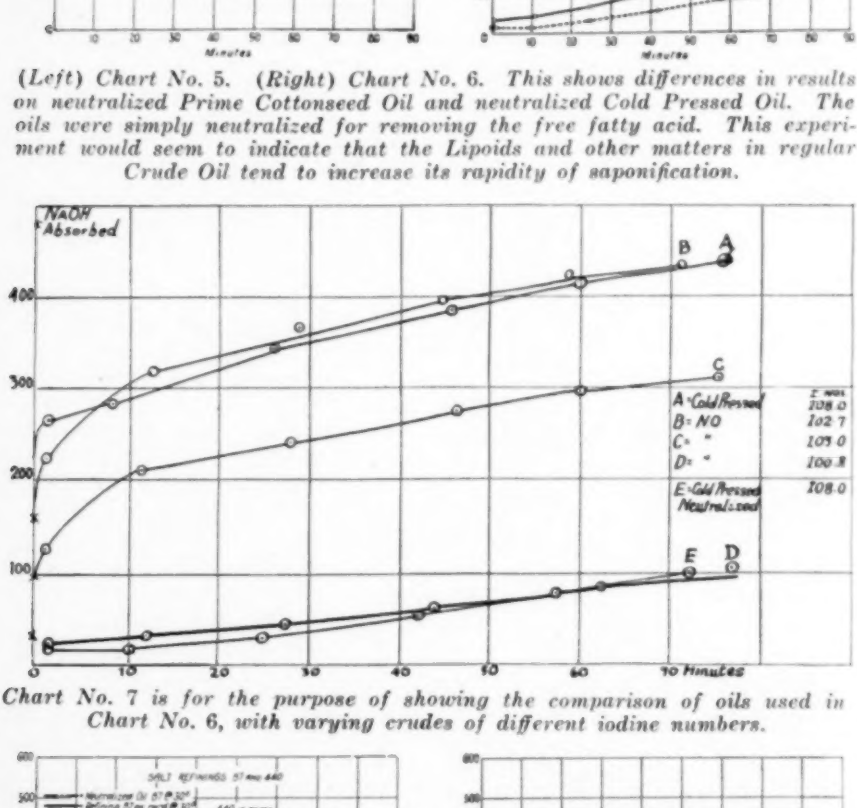


Chart No. 7 is for the purpose of showing the comparison of oils used in Chart No. 6, with varying crudes of different iodine numbers.

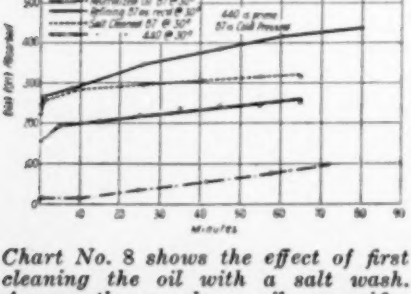


Chart No. 8 shows the effect of first cleaning the oil with a salt wash. Apparently a clean oil saponifies more slowly than an oil which has not been so cleaned.

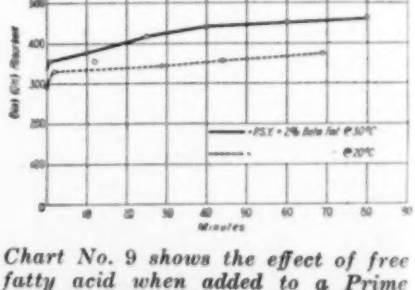


Chart No. 9 shows the effect of free fatty acid when added to a Prime Summer Yellow Oil. It is interesting particularly in showing the effect of temperature on the reaction.

was used to make .50 per cent NaOH on the oil. The oil was neutral and did not absorb any NaOH analytically.

Experiment Nos. 2 *and* 3: In these experiments about 1 per cent of distilled fatty acids were added to the crude and the absorption determined, and results plotted in curves A at 22.5°, B at 43°.

It will be noted that in the presence of soap the absorption increases with time, and more rapidly at the higher temperature.

The data are given in the table headed Chart 4.

The theoretical absorption of the mixture is .183 per cent and it will be noticed that this is about where the curves, laid out from the above data, cross. The mixture used at 43° contained .92 per cent F. F. A. That used at 22.5° contained .95 per cent F. F. A. In each case there was present .50 per cent NaOH in excess of that required by the F. F. A. The lye used was 9°.

Experiment No. 4: This was made at 20°, using 2 per cent Fatty Acid in the oil. Results are shown in Curve D. It would appear from the curve that in presence of a large amount of Fatty Acids at low temperature the soap formed surrounds the lye globules and retards absorption.

Experiment No. 4

Prime Refined Oil containing 2 per cent of added fatty acid was treated with caustic to determine the rate of absorption. Used .78 per cent of NaOH, i.e., 0.5 per cent more than was needed to combine with F. F. A.

Minutes	Absorption	Temperature Degrees
0	0	20.0*
2	.330	20.8†
12	.352	20.7
29	.341	20.6
44	.352	20.6
69	.374	20.6

* Start. † Very thick mass to sample.

Cold Pressed Oil

Two tests were run, one in the regular manner, using excess

Experiment No. 1

Table Showing Rate of Absorption of NaOH by P. S. Y.

Minutes	Absorption	Temperature Degrees	
0	0	20.1	
10	0	20.4	
25	0	20.5	
30	0	20.5	
40	0	20.5	
60	0	20.5	
80	0	20.7	
87	0	25.0	
92	0	30.0	To draw curve for absorp-
96	0	35.0	tion we start with 0 Minutes
100	.003%	40.0	0
130	.032	43.6	30
145	.064	43.0	45
160	.117	43.0	60
175	.149	43.4	75
195	.170	44.0	95

EXPERIMENTS ON REFINED OIL—CHART NO. 4

Table Showing Absorption of NaOH by P. S. Y. Containing .93 Per Cent Beta Fat

Curve A—Experiment No. 2 At 22.5° C.			Curve B—Experiment No. 3 At 43 ° C.		
Minute	Absorption	Temperature Degrees	Minute	Absorption	Temperature Degrees
0	0	22.0	0	0	43.0
1	.145	22.0	1	.134	43.2
12	.161	22.3	7	.142	43.2
33	.177	22.4	22	.177	42.9
54	.183	22.5	33	.188	43.0
75	.204	22.5	52	.220	43.4
84	.204	22.5	71	.253	43.8
99	.215	22.5	97	.306	42.3

NaOH, the other using just enough NaOH to neutralize the F. F. A.

These curves are interesting as showing the excessive saponification in one case, and the gradual neutralization in the other.

It is worthy of remark that the cold pressed oil when treated with just enough caustic to neutralize it gave a refined oil, indicating absence of bodies which prevent ordinary crude from acting in the same manner.

In studying Chart 5 it will be noted that where the excess caustic was used, as shown by Curve A, there was a steady increase in the absorption after the addition of the lye, while on Curve B, where just enough caustic was used to meet the requirements of the absorption test, there was a rapid absorption at the start and a very slow increase afterwards during the entire operation of the experiment. The two curves cross each other at .31, which is somewhat below the point

(*Continued on page* 111)

CHART NO. 5

Table Showing Rate of Absorption of NaOH by Cold Pressed Cotton Seed Oil

	Excess NaOH Used	NaOH = Alkali Absorption
F.F.A.	1.55	1.55
NaOH for F.F.A.	.22	.22
NaOH for Color, etc.	.38	.135
NaOH Used	.60	.355
NaOH Absorbed (Analysis)	.355	.355
NaOH Used in Excess	.245	.000
Sp. Gr. Lye	1.091	1.091

Min.	Abs.	Temp. Deg.	Min.	Abs.	Temp. Deg.
0	0	29.6	0	0	30.8
1	.263	30.5	1	.282	32.0
8	.285	30.5	11	.304	31.9
26	.344	30.5	25	.319	31.8
45	.382	30.9	42	.335	31.3
60	.414	31.0	60	.340	31.0
76	.438	30.7	78	.345	30.0

The Examination of Mixtures of Coconut Oil and Palm Kernel Oil and the Determination of Butter Fat in Margarine*

By G. D. Elsdon, B.Sc., F.I.C. and Percy Smith

SOMEWHAT recently the present authors in a paper dealing with the Reichert-Polenske figures of mixtures of palm kernel oil and other fats (*Analyst*, 1926, 51, 72) pointed out that the relationship between the Reichert and Polenske values of a mixture of fats might give useful assistance in distinguishing between coconut and palm kernel oils, and even within certain limits give some indication as to the relative amount of the two fats present. This suggestion has now been followed up, and the Reichert and Polenske values have been determined for a complete range of mixtures of these two oils. The

*Read at the Meeting of the North of England Section, November 13, 1926, and published in *The Analyst*, February, 1927.

TABLE I.

REICHERT AND POLENSKE VALUES OF COCONUT AND PALM KERNEL OILS.

Palm-kernel oil per cent	Process.	Percentage of Coconut Oil.										
		0	10	20	30	40	50	60	70	80	90	100
0	Reichert	0.6	2.0	3.3	4.4	5.2	5.7	6.3	6.6	6.9	7.2	7.4
	Polenske	0.4	1.4	2.3	3.5	5.1	6.8	9.4	11.8	13.8	15.2	16.8
10	Reichert	1.2	2.5	3.6	4.7	5.5	6.1	6.5	6.8	7.0	7.3	...
	Polenske	1.2	2.1	3.6	4.8	6.5	8.4	10.6	12.4	14.6	16.6	...
20	Reichert	1.8	3.3	4.2	5.0	5.7	6.3	6.6	6.9	7.2	...	...
	Polenske	1.7	2.6	4.4	5.4	7.6	9.6	11.5	13.3	15.4	...	...
30	Reichert	2.2	3.7	4.7	5.2	5.9	6.5	6.7	7.0	...	...	...
	Polenske	2.5	3.6	5.1	7.2	8.8	10.3	12.5	14.4	...	...	...
40	Reichert	2.6	4.0	5.0	5.5	6.2	6.6	6.8	...	...	...	...
	Polenske	3.2	5.1	6.8	8.4	9.5	11.8	14.0	...	...	...	...
50	Reichert	3.1	4.4	5.3	5.8	6.4	6.7	...	...	...	...	...
	Polenske	4.3	6.0	8.0	9.3	11.2	13.0	...	...	...	...	...
60	Reichert	3.5	4.8	5.6	6.1	6.6	...	...	...	...	...	...
	Polenske	5.6	7.6	9.1	10.8	12.6	...	...	...	...	...	...
70	Reichert	3.9	5.2	5.9	6.3	...	...	...	...	...	...	...
	Polenske	6.2	8.5	9.7	12.3	...	...	...	...	...	...	...
80	Reichert	4.3	5.5	6.1	...	...	...	...	...	...	...	...
	Polenske	7.4	9.5	11.5	...	...	...	...	...	...	...	...
90	Reichert	4.7	5.6	...	...	...	...	...	...	...	...	...
	Polenske	8.6	10.6	...	...	...	...	...	...	...	...	...
100	Reichert	4.8	...	...	...	...	...	...	...	...	...	...
	Polenske	9.7	...	...	...	...	...	...	...	...	...	...

results obtained are given in Table I.

It has not been thought necessary to determine the Kirschner value in each case, for the previous papers (*Analyst*, 1925, 50, 53; 1926, 51, 72) showed, as was indeed previously known, that there is a very definite mathematical relationship between this figure and the amount of coconut and/or palm kernel oil present. For the same reasons mixtures containing butter fat have not been studied, as in this case also the Kirschner value is a linear function of the amount of butter fat present, whilst the effect of the presence of butter fat on the Reichert and Polenske values may be allowed for by finding the approximate percentage of butter from the Kirschner value (in conjunction with the Polenske value) and subtracting the calculated Reichert and Polenske values due to this amount of butter from the observed figures, the result giving the Reichert and Polenske values due to the coconut and palm kernel oils present, together with, of course, the small amount due to any neutral fats.

Although this may seem rather complicated, it is really quite

TABLE II.

DETERMINATION OF BUTTER FAT IN MARGARINE

	Butter Fat Per Cent										
	0	1	2	3	4	5	6	7	8	9	10
Polenske	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	1.0
Kirschner	0.2	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7
Polenske	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6
Kirschner	0.3	0.6	0.8	1.1	1.3	1.6	1.8	2.1	2.3	2.6	2.8
Polenske	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6
Kirschner	0.5	0.8	1.0	1.3	1.5	1.8	2.0	2.3	2.5	2.8	3.0
Polenske	3.0	3.1	3.1	3.2	3.2	3.3	3.4	3.4	3.5	3.5	3.6
Kirschner	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.2
Polenske	4.0	4.1	4.1	4.2	4.2	4.3	4.4	4.4	4.5	4.5	4.6
Kirschner	0.8	1.1	1.3	1.6	1.8	2.1	2.3	2.6	2.8	3.1	3.3
Polenske	5.0	5.1	5.1	5.2	5.2	5.3	5.4	5.4	5.5	5.5	5.6
Kirschner	0.9	1.2	1.4	1.7	1.9	2.2	2.4	2.7	2.9	3.2	3.4
Polenske	6.0	6.1	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.5	6.6
Kirschner	1.0	1.3	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.3	3.5
Polenske	8.0	8.1	8.1	8.2	8.2	8.3	8.4	8.4	8.5	8.5	8.6
Kirschner	1.1	1.4	1.6	1.9	2.1	2.4	2.6	2.9	3.1	3.4	3.6
Polenske	10.0	10.1	10.1	10.2	10.2	10.3	10.4	10.4	10.5	10.5	10.6
Kirschner	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7
Polenske	12.0	12.1	12.1	12.2	12.2	12.3	12.4	12.4	12.5	12.5	12.6
Kirschner	1.3	1.6	1.8	2.1	2.3	2.6	2.8	3.1	3.3	3.6	3.8
Polenske	14.0	14.1	14.1	14.2	14.2	14.3	14.4	14.4	14.5	14.5	14.6
Kirschner	1.4	1.7	1.9	2.2	2.4	2.7	2.9	3.2	3.4	3.7	3.9
Polenske	15.5	15.6	15.6	15.7	15.7	15.8	15.9	15.9	16.0	16.0	16.1
Kirschner	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.0

simple; an example may make it clearer. A sample of margarine is found to have Reichert value 6.2; Polenske value, 5.3; Kirschner value, 2.5; it is required to find its composition. From Table III (*Analyst*, 1925, 50, 57) or Table I (*Analyst*, 1926, 51, 73) it is seen that a fat having a Kirschner value of 2.5 with a Polenske value of 6.2 contains 6 per cent of butter fat. The Reichert value due to 6 per cent of butter fat is 1.5, whilst the Polenske value is 0.2. Subtracting these figures from the experimental results obtained for the sample of fat in question, we get 4.7 and 5.1 as the Reichert and Polenske figures, respectively, of the sum of the coconut, palm kernel and neutral oils present in the mixture. The proportion of coconut and palm kernel oils is then obtained from Table I as described below, and is found to be coconut oil 20 per cent; palm kernel oil 30 per cent.

In order that the process of finding the approximate percentage of butter fat present in a mixture may be made as easy as possible, Table II has been compiled.

This table, which is more or less ideal, is a composite one which has been developed from graphs from the tables given in the two papers to which reference has already been made. Its mode of use will be fairly obvious. When the Polenske and Kirschner values of a fat are known, the horizontal lines in the table are examined until the two figures are found; the figure at the top of the vertical column will indicate the amount of butter fat in the mixture. For example, in the case of a given mixture of fats the Polenske and Kirschner values were 5.6 and 2.5 respectively. The two nearest figures to these are 5.4 and 2.4, from which the interpolated value for the percentage of butter fat is 6.3; the actual proportion added was 6.0 per cent.

An examination of Table I will show that the Reichert value due to palm kernel oil alone (mixed, of course, with neutral fat in varying proportions) is in all cases numerically less than the Polenske value, whilst in the case of coconut oil alone the Reichert value is the greater until about 40 per cent of coconut oil is present. The table has been subjected to critical examination by H. D. Richmond, to whom the authors are greatly indebted. Mr. Richmond writes as follows: "I think the most that can be expected from your results are, first, it is possible to distinguish coconut oil and palm kernel oil; second, that when the two exist in the same mixture and the percentage of coconut oil is well under 50 per cent, an approximate idea of the relative proportions of the two oils can be deduced within about 15 or 20 per cent either way."

It should be emphasized that the accuracy of the process depends upon the factors of the oils—chiefly of the butter-fat—which have been used in the mixtures, and also that different mixtures of coconut and palm kernel oil may give identical results, as will be seen from an inspection of the table.

In such cases, therefore, the composition of the coconut oil class part of the oil should be checked by one of the recognized methods, that of Shrewsbury and Knapp (*Analyst*, 1910, 35, 385), which gives the total amount of such oil, being particularly suitable. Other processes are those of Burnett and Revis (*Ibid.*, 1913, 38, 255) and Stokoe (*J. Soc. Chem. Ind.*, 1921, 40, 57T). It is highly desirable that when the composition of a

(*Continued on page* 111)

Oven Drying Method for the Determination of Moisture in Cottonseed Meal

By PAUL SHERRICK

RECENT investigations by the Moisture Committee of the American Oil Chemists Society comparing the loss of weight and distillation methods for moisture in cottonseed meal have again brought the technique of this important determination under a variety of criticisms. The attitude of the Committee is indicated by its report published in OIL & FAT INDUSTRIES, June, 1926, as follows:

"Your committee knows of no other analytical process in which we are concerned that needs greater special attention than moisture determination, as shown by our moisture results on check meal work and on our past year's work using the Bidwell-Sterling method; and these results also show conclusively that many of our laboratories are not equipped with a uniform and constant temperature oven."

Vacuum oven drying as the official or published referee's method, dates back to the Tentative Standard Methods published in September, 1916 by the Committee on the Analysis of Commercial Fats and Oils, Division of Industrial Chemists and Engineers of the American Chemical Society (*Journal of Industrial and Engineering Chemistry*, Vol. 9, No. 11). At that time an alternative routine procedure using air ovens was also outlined. In the report of the Committee's adoptions, as drawn up by W. D. Richardson, it is stated, "The Committee has also considered the various distillation methods for the determination of moisture in fats and oils, but . . . . it was decided that the most desirable method was the vacuum oven method as described."

That Committee also submitted the design for a so-called standard vacuum oven which it was hoped would be capable of the required degree of control. This oven, however, has not allowed a sufficiently ready maintenance and duplication of conditions as shown by the inevitable small but significant discrepancies between reports of different collaborators on test samples at various times. A number of other commercial vacuum ovens subsequently produced have led to no reduction of this working variable. At the same time the air drying ovens used by control laboratories following the alternative recommended method have shown very poor temperature control and uniformity and caused occasional gross errors in moisture reports covering raw materials in transit or storage.

Out of this general situation has arisen the present interest in applying to cottonseed meal the distillation method recommended by Bidwell and Sterling for a variety of raw materials. This principle has been employed to some extent for the last twenty years in methods applied to grain by Brown and Duvel, to crude fibre by Schwalbe, to leather by Rogers, and to petroleum products by Dean and Starck.

The present method as developed by Bidwell & Sterling has some theoretical superiorities over any loss of weight method as pointed

out by Mr. Bidwell (*Journal of Industrial & Engineering Chemistry*, Vol. 17, No. 2, namely, (1) it is free from effects of variable humidity; (2) possible losses in weight from slight oxidation of the sample are avoided; and (3) it proposes to measure actual water rather than water and volatile matter. The last contention is, of course, not strictly true, since the distillate in the Bidwell-Sterling method is liable to contain some volatile matter miscible with water which could introduce a positive error in the volume reading. If the quantity of volatile waste included in the results secured by the drying method were appreciably greater than the similar error by the distillation method, the former would be expected to yield a higher moisture figure. Actually, however, oven drying reports are consistently lower than distillation reports on the same samples by an amount in the vicinity of 0.3 per cent of dry sample weight. This almost constant difference must be attributed either to a more extensive inclusion of substances other than water by the distillation method or to the retention of some mechanically held moisture by a dried sample even after it has reached apparent constant weight under the specified conditions.

In either case, a major consideration in establishing the more practical method in the hands of laboratory chemists would seem to be a decision as to which permits the closest possible duplication of results when used by different operators in various laboratories. In this connection data published in the report of the Moisture Committee, this Journal for June, 1926, appears to be somewhat in favor of the oven method. During the year 1925, six samples of cottonseed meal were submitted to a large number of collaborators for moisture reports by the Bidwell-Sterling and the oven drying methods. Successive samples were sent to the same chemists with the result that any unaccustomed to the Bidwell-Sterling method should have become familiar with its manipulation by the time the later samples of the series were sent out. For the purpose of estimating the uniformity of results by either method in the hands of numerous operators, the most significant figure which can be secured from this collection of results is the mean deviation from the mean. In other words, having determined the average value for moisture percentage from collected reports on a given sample, each individual variation from this average is computed and the average of all these deviations is a figure indicating the probable duplication of results on a given sample by different operators. The accuracy of this figure is, of course, a function of the total number of determinations from which it is calculated. These mean deviations from the means as computed from the third, fourth, fifth, and sixth samples of the Committee's series are as follows:

		Mean deviation from the mean in % of dry weight.	
Sample	No. of reports	Bidwell-Sterling	Oven Drying
3	25	0.47	0.28
4	17	0.48	0.24
5	14	0.37	0.23
6	13	0.26	0.24

In comparing these figures it should be remembered, of course, that the Bidwell-Sterling method was comparatively new in the hands of some operators.

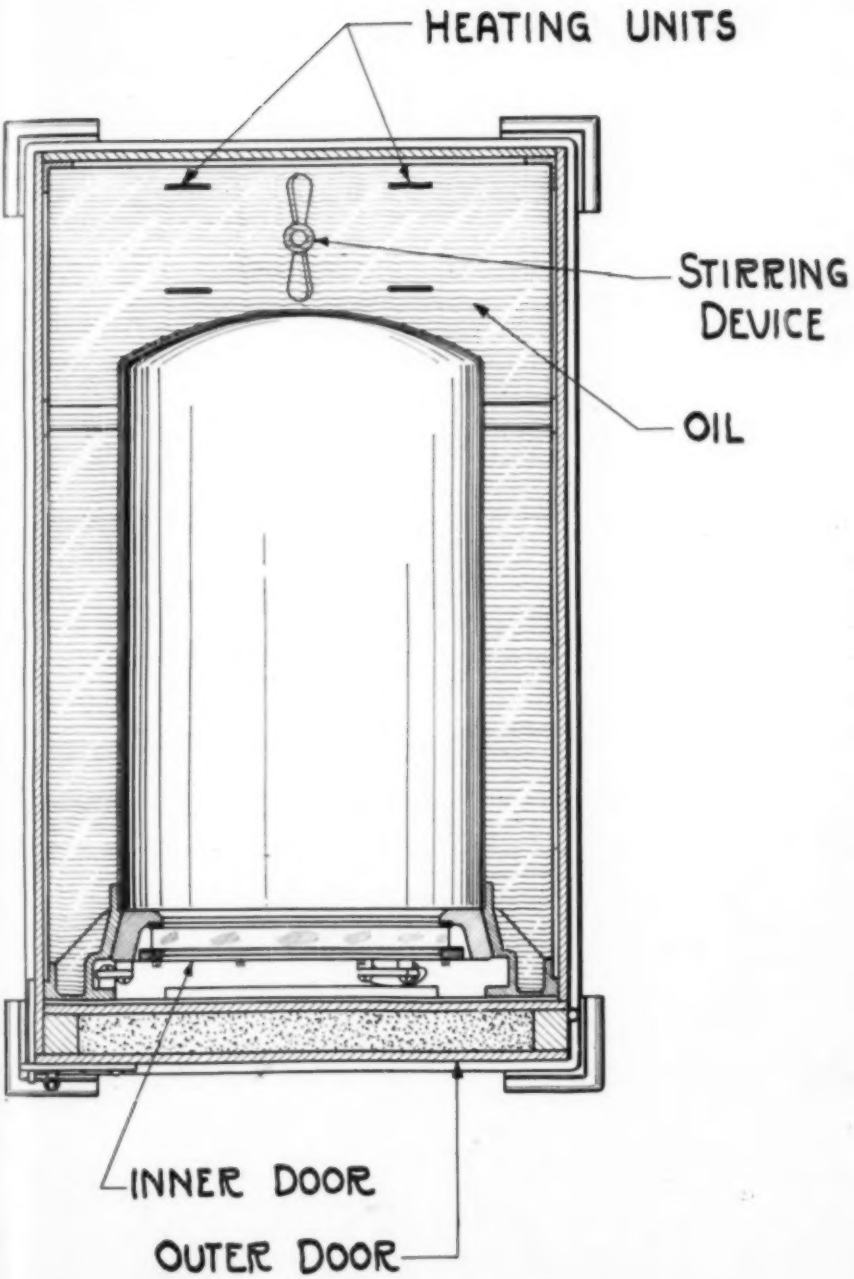
Variations in the oven method are accounted for to a large extent by the lack of temperature control

and uniformity which characterizes a large number of the air drying and vacuum ovens in use in control laboratories. Referee's results on moisture in flour indicate that temperature variations in oven drying begin to affect moisture results when such variations approach a magnitude of 5° C (*Journal of the Association of Official Agricultural Chemists*, Vol. 9, No. 4, page 404). Moisture results on cottonseed meal are probably affected to a similar extent. The actual magnitude of local temperature differences in many well-known and widely used air drying ovens which employ primarily a direct radiation system often reaches 30°C between the top and bottom shelves, or 15°C on one shelf and a similarly large variable is found in direct or air heated vacuum ovens. In the field of oven design, work of the past five or six years, carried on by the Central Scientific Company of Chicago, and directed upon the problems of heat control and distribution in closed chambers is of particular importance, inasmuch as it has produced an oven of each type, air drying and vacuum, whose working variations in temperature and pressure are well within the apparent significant limits for this determination. These are the DeKhotinsky air drying oven and the new Cenco vacuum oven.

Distribution of heat in the DeKhotinsky ovens is secured by properly balancing the effects of direct radiation and convection. These two elements are the important factors in the thermal characteristics of any oven. The former establishes a temperature gradient with its high at the bottom and its low at the top of the oven chamber. Convection currents tend to establish a reverse gradient with warmer air above being replaced by cool air below. By effectively increasing and distributing the convection factor, the DeKhotinsky oven balances these two gradients and at the same time maintains an equally effective lateral circulation. Exhaustive measurements of heat distribution have been carried out by loading the ovens with sample dishes of oil meal, each dish containing its own thermo-element. All these measurements show a probable maximum temperature difference between any two points in the oven of 3°C. It is highly improbable that this variation could ever appear in any moisture determinations reported in the usual way to 0.01 per cent of dry weight. Under these conditions routine tests may be conducted in large numbers simultaneously by loading the oven to a reasonable capacity, which is obviously one of the strong appeals of the air drying method to the control chemist.

Experience with a variety of former vacuum ovens has shown that the necessary temperature control and uniformity cannot be obtained by the direct application of intermittent heating to the chamber proper. Several manufacturers have used a thermostatic air bath as the heat transmitting medium, but this method, up to the present time, has not produced a reasonably close control in the drying chamber. The third logical plan has been employed with excellent results in the new Cenco vacuum oven, namely, immersion of the vacuum chamber in a circulating oil thermostat.

The oil bath itself is controlled to variations less than ± 0.5°C, by means of the well-known DeKhotinsky bi-metallic thermo-regulator, Bureau of Standards form Knife Type heaters, and motor driven stirrer. The drying chamber

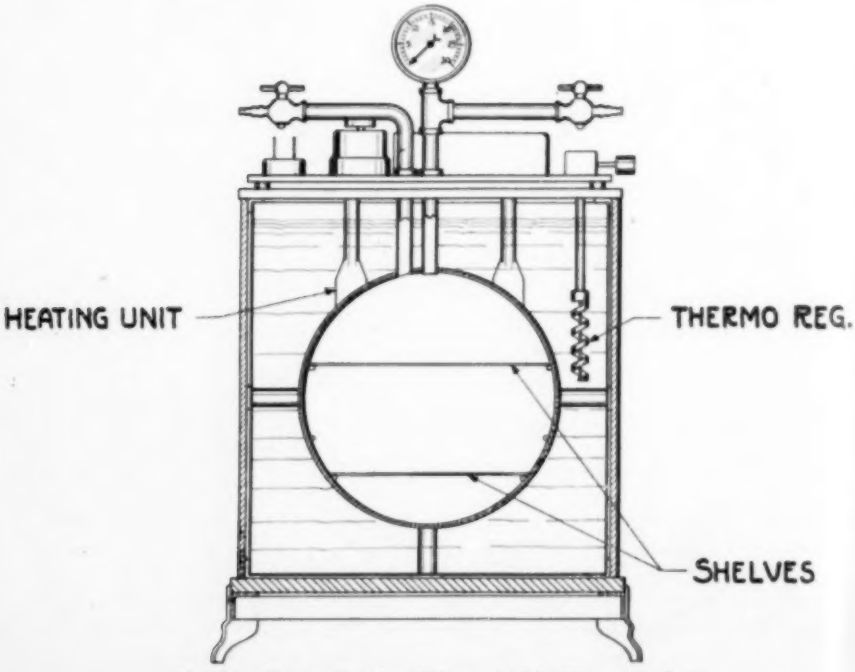


A Cross Section View of the Vacuum Oven

proper is cylindrical in form, 9" in diameter, and 14" long, allowing the use of three shelves. The door consists of a circular bronze casting with a pane of heavy Pyrex glass and fits into a tapered brass seat. An effective seal is achieved by properly grinding the door into its seat. The accompanying diagrams, illustrate the construction in detail.

A great number of exhaustive tests have been made on these vacuum ovens to establish the exact performance that may be expected from them. Uniformity of distribution has been repeatedly measured by placing sample dishes of sand at the extreme ends and sides of the three shelves, each containing its own thermo-element, and each compared with a central dish at the thermometer bulb as reference standard. In none of these tests has the average total difference between two widely separated samples been more than 1°C, and the largest total variation on record is 1.4°C. It is undoubtedly safe to assume a general working limit of uniformity to be ± 0.5°C. Figure 3 is a three-hour section from a characteristic test curve, showing simultaneous temperatures in the oil bath and in the oven chamber at its axis. With reasonably constant room temperature, the oven temperature, as read from the thermometer, seldom varies as much as 0.5°C. This curve was taken when the chamber was at a pressure of 3 mm. of mercury.

The use of ovens, either air or vacuum, for the determination of moisture in cottonseed meal has its greatest value in the convenient handling of a considerable number of samples with the least demand on the attention and time of the



Another Cross Section View of this Vacuum Oven

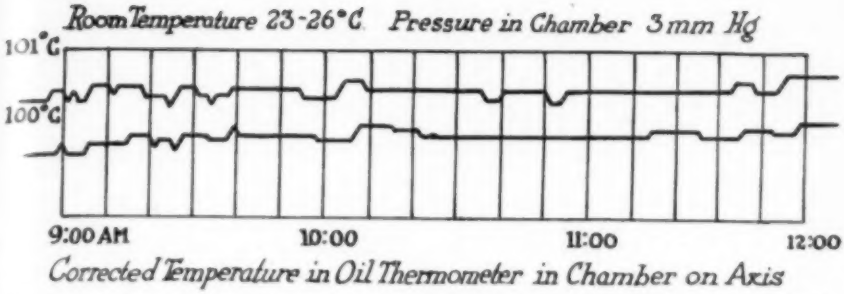


Fig. 3. A three-hour section from a characteristic test curve, showing simultaneous temperatures in the oil bath and in the oven chamber at its axis.

chemist. Wherever this method is employed it appears highly possible, by the use of ovens similar to those that were described above, to achieve a generally uniform measure of moisture in routine control in which probable variations among different laboratories should be reduced to a quantity of no commercial significance whatever.

Examination of Mixtures

(*Continued from page* 105)

mixture of oils has been deduced a new mixture should be made having this composition, and the values obtained therefrom compared with those of the original. In this way a very near approximation to the truth may be obtained.

The detection of small amounts of butter in margarines, which is sometimes required, may be carried out by this method supplemented by the method of Gilmour (*Analyst*, 1920, 45, 2; 1925, 50, 272). Experiments along these lines have been carried out, and it is hoped to publish the results obtained.

It may not be out of place at this stage to remind workers that practically the whole of our knowledge of the examination of margarine is due to the pioneering work of Cribb and Richards and Bolton, and of Revis and Richmond. The present authors are glad to acknowledge their indebtedness to these workers, and to state that, at best, they can only claim to have confirmed and possibly somewhat extended the earlier work.

Alkali Absorption in Crude Oil Refining

(*Continued from page* 102)

indicated by analysis. This would indicate that the globules of caustic solution do not come in such contact with the oil that all the caustic is taken up till after a long time of stirring. It also indicates the effect of excess caustic in producing excess saponification.

Adam Hilgar, Ltd., Publishes Bulletin

Adam Hilgar, Ltd. manufacturers of instruments for scientific research, have recently issued a new 32-page bulletin covering the work of their research and sales departments for the year ending December 31, 1926. The bulletin describes new instruments as well as changes and improvements in the standard Hilgar line.

A Rapid Method for the Sorting of Butters and Margarines *

By C. H. MANLEY, M.A., F.I.C.

THE disadvantage of the Reichert process, if comparable results are to be obtained, lies in the close attention that must be paid to the details of the distillation process. The present paper deals with a rapid method of sorting butters and margarines, and depends, like the Reichert process, upon the butyric acid content. No distillation is involved, and the figures obtained with butters closely approximate to those obtainable from Kirschner determinations. In the case of margarines the figures (with one exception) whilst being somewhat higher than the corresponding Kirschner values, are still, as with butters, lower than the corresponding Reichert values. For twenty butters examined the figures ranged from 20.6 to 26.4, whilst for eighteen margines the limits were 0.0 and 5.1. (See Tables I and II.)

The New Method. The following are the details of the process: Five grams of the filtered fat are saponified with 20 c.c. of glycerol soda solution (made by mixing 900 c.c. of pure glycerol with 100 c.c. of a 50 per cent aqueous solution of

*Read before the Society of Public Analysts.

TABLE I.

Butters.

No. of sample	Reichert (R)	M value	Kr.	Km.	Polenske	Boric acid Per cent
1	28.0	26.4	...	...	1.2	...
2	27.8	23.4	...	...	2.2	...
3	29.4	22.8	...	...	2.4	...
4	27.0	23.4	...	...	1.8	...
5	28.9	26.3	...	...	1.7	...
6	29.1	25.6	...	...	2.2	...
7	28.5	21.6	...	...	1.9	...
8	27.0	21.6	...	...	...	...
9	28.2	23.0	...	...	1.7	...
10	27.6	22.2	...	...	1.7	0.03
11	...	21.9	...	21.9	...	...
12	...	22.1	...	22.1	...	...
13	28.6	26.2	25.2	26.6	1.5	...
14	...	22.3 / 22.1	...	22.6	...	...
15	...	20.6	...	...	...	...
16	29.0	23.1†	...	...	...	...
17	...	20.6	...	...	...	...
18	...	22.2	...	21.9 / 22.0 / 23.2		
19	...	23.2	...	23.1	...	...
20	27.2	22.5	23.1	22.7	...	...

† Increased to 24.2 by hot water washing of the insoluble acids.

TABLE II.

Margarines.

No. of sample	Reichert	M. value	Kr.	Km.	Polenske	Boric acid Per cent
1	5.5	2.5	1.6	1.9	4.6	...
2	4.2	2.8	2.1	1.6	4.6	0.23
3	5.0	2.6	1.1	1.2	3.9	0.15
4	3.9	1.2	1.0	0.9	4.8	...
5	5.8	2.2	1.7	1.7	5.5	0.20
6	5.3	2.4	1.2	1.6	6.5	0.14
7	4.9	3.4	2.6	1.2	4.9	...
8	4.7	1.6	1.3	1.3	4.1	0.27
9	2.3	1.8 / 1.8	1.7	1.4	0.6	0.33
10	8.5	5.1	3.8	3.8	2.8	0.20
11	...	Nil	...	Nil	...	0.33
12	...	Nil	...	Nil	...	0.20
13	...	2.0	...	1.4	...	0.20
14	4.5	3.0	2.2	1.4	1.3	0.22
15	2.5	2.5	2.5	2.5	1.3	0.02
16	5.4	1.6	1.3	1.4	5.9	...
17	...	1.2	...	...	...	0.25
18	...	2.3	...	...	...	0.29

sodium hydroxide) and the soap dissolved in 100 c.c. of boiled distilled water. Into the cooled solution 4 drops of 0.5 per cent methyl orange solution are introduced and sulphuric acid (25 per cent by volume) added from a burette until the solution is faintly pink. The total volume of the solution and precipitated fatty acids is taken and 100 c.c. filtered off,* nearly neutralized with 10 per cent. sodium hydroxide solution, and the neutralization completed with 0.1 *N* sodium hydroxide solution. In this way the sulphuric acid is neutralized, leaving only soluble fatty acid, which is then titrated with 0.1 *N* sodium hydroxide, after the addition of 0.5 c.c. of 0.5 per cent phenolphthalein solution. The number of c.c. of 0.1 *N* sodium hydroxide solution taken, less the number required for a blank, is represented as the M value.

The blank is carried out upon 20 c.c. of glycerol soda solution dissolved in 100 c.c. of distilled water (free from carbon dioxide). In measuring the glycerol soda solution, 20 c.c. are poured into a 25 c.c. cylinder, and after the bulk has been transferred to the flask, four drops are allowed to enter, after which the cylinder is removed. In this way a reasonably uniform quantity is used in each case.

If to the neutral solution, obtained as above from a butter-fat, 0.5 gram of silver sulphate is added, and a Kirschner determination made, the value obtained in every case is the same, or very nearly the same, as the M value.

Significance of the Km Value. This figure is referred to as the Km value, as distinct from Kr, the ordinary Kirschner value. These results seem to indicate that the volatile soluble acids other than butyric are co-precipitated with the insoluble acids, and this theory is to some extent borne out by the fact that when the insoluble acids are washed several times in a separating funnel with hot water, and the washings passed through

*By using 18.5 cm. paper, the whole of the solution may be transferred at once, thus saving unnecessary expenditure of time in supervision of the filtration.

TABLE III.

Mixtures of Butter Fat with Coconut Oil.

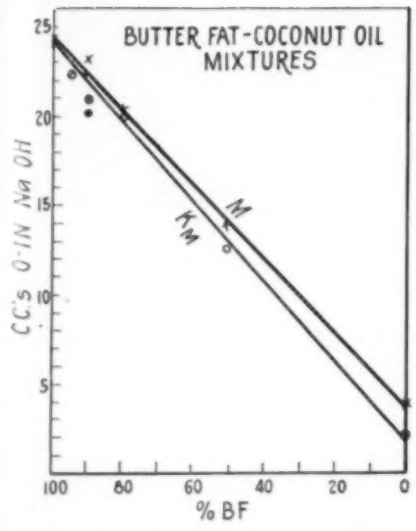
	M.	Km.	(M-Km).	Reichert.	Kr.	Polenske.
Butter fat, 100 per cent...	24.3	24.1	0.2	28.9	24.8	2.6
Butter fat, 95 per cent.... / Coconut oil, 5 per cent.....	22.1	22.1	0.0	27.7	23.5	2.7
Butter fat, 90 per cent....	23.0	20.7	2.3	26.7	22.1	3.9
Coconut oil, 10 per cent...	22.0	19.9	2.1			
Butter fat, 80 per cent.... / Coconut oil, 20 per cent...	20.3	19.9	0.4	25.0	20.1	4.5
Butter fat, 50 per cent.... / Coconut oil, 50 per cent...	13.7	12.4	1.3	19.2	13.7	7.9
Coconut oil, 100 per cent..	3.8	2.0	1.8	8.2	2.6	13.4

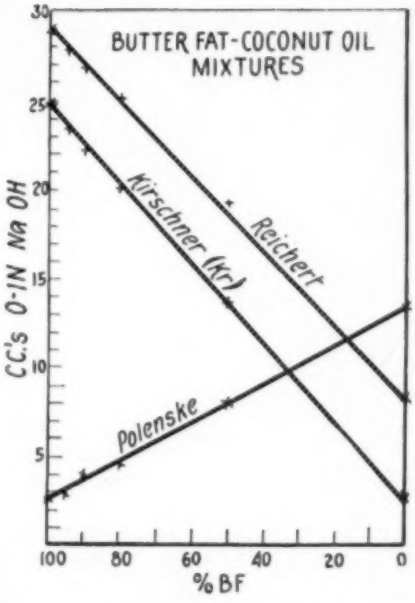
a filter paper, an increase in the M value results, although even so it does not become equal to the Reichert figure (Butter No. 16). This may possibly be accounted for by the preferential solubility of the soluble acids (other than butyric) in the liquid layer of the higher fatty acids (partition coefficient).

Detection of Coconut and Palm Kernel Oils in Butter Fat. For margarines, speaking generally, the Km value is lower than the M value. In margarines in which the presence of coconut or palm kernel oil has been indicated by the Reichert-Polenske-Kirschner determinations it would appear that some of the caprylic acid escapes co-precipitation, and this fact, along with the identity of the M and Km values in the case of butter-fats, suggested the possibility of detecting coconut and palm kernel oils, when present in butter-fat, by means of the difference which might exist between the M and Km values in such cases. To this end mixtures of butter-fat and coconut oil were prepared containing 5, 10, 20, and 50 per cent of the latter, the M and Km values, and also the Reichert - Polenske - Kirschner values, being then determined and the results plotted. (See Table III and Curves.) No difference was observable in the 5 per cent coconut oil mixture between the M and Km values, and only a slight one (0.4 c.c.) in the 20 per cent mixture. In the 50 per cent mixture the difference amounted to 1.3 c.c., no very great amount in view of the proportion of coconut oil present. On the other hand, the 10 per cent mixture showed a difference of 2.3 c.c.—a figure that was supported by a check determination

TABLE IV.

	Reichert	Kr after precipitation lasting— 60′	30′	15′	5′
Margarine No. 10..	8.5 / 8.6	3.8	...	4.0	3.9
Butter No. 21.....	27.8 / 28.1	22.9	22.7	23.7	..
	M value.	**Km after precipitation lasting— 60′**	**30′**		
Butter No. 19.....	23.2	23.2	23.1	...	..





which yielded a difference of 2.1 c.c. In view, however, of the slight differences obtained with the 20 per cent and 50 per cent mixtures, it would be difficult to formulate any definite conclusions. It was thought, however, that a qualitative test might be used, based upon the surmise that silver nitrate (or silver sulphate) added to the solution obtained in the M value determination would produce no turbidity in the case of a genuine butter (owing to the identity of the M and Km values) if sodium hydroxide free from chloride were used throughout, but that a turbidity would ensue if coconut or palm kernel oil were present.

Limitations of the Test. The alcoholic sodium hydroxide used for the saponifications and the aqueous sodium hydroxide solution used for the titrations in these tests were prepared from metallic sodium. The solutions were free from chloride. No turbidity was obtained with silver nitrate or silver sulphate in the case of a genuine butter fat, and only the faintest indication of such with a fat containing 5 per cent of coconut oil. At a concentration at which an appreciable turbidity was obtainable it was found that an approximately equal turbidity was yielded by the solution prepared from a pure butter-fat.

Thus it is not considered that this test can serve to distinguish butter fat in samples containing 5 per cent coconut oil.

Since these experiments were carried out, some chloride-free glycerol sodium hydroxide solution has been prepared, with results that have supplemented those obtained with the alcoholic sodium hydroxide solution.

Experiment has shown that boric acid has no effect on the M value. A clear filtered margarine fat was tested for boric acid alongside some of the whole margarine; the whole margarine showed the presence of boric acid, whilst the filtered fat gave a negative reaction.

Whilst, as yet the method here described for examining butters

cannot claim the accuracy of the Polenske process, it can be used instead with advantage in the examination of margarines, for the majority of which no butter content is expected, and for these the possibility of a butter fat content in excess of 10 per cent is, for obvious reasons, extremely small. Of the 20 margarines examined, in only one case did the M value exceed 3.4. In this case (No. 10. M =5.1) the Polenske-Kirschner figures corresponded with a 10 per cent butter content. In this case also, and in several others, the Km and the Kr values were identical. Generally, where the M value is 5.0 or over, determinations of both the Km and Kr values are recommended.

It has been found that for margarines a period of five minutes is sufficient time for the complete precipitation of the silver salts in Kirschner determinations. This effects a saving in the time of one hour recommended by Kirschner and adopted by Revis and Bolton. Similarly, for butters, thirty minutes were found sufficient. (See Table IV).

In conclusion, I wish to express my thanks to Mr. Harri Heap for his interest and criticisms.

Cotton in California

Cotton has become established as one of the leading industries of California. Last year 160,000 acres were planted which yielded 128,000 bales. To handle this crop, there are 82 gins, 5 compresses and 16 oil mills. By counties, the acreage devoted to cotton is as follows:

Kern County	35,000 bales
Tulare County	21,000 bales
Fresno County	21,000 bales
Kings County	21,000 bales
Madera County	10,500 bales
Merced County	9,600 bales
Stanislaus County ..	4,900 bales
San Joaquin Valley..	114,000 bales
Riverside	23,300 bales
Imperial Valley	26,000 bales

Ninety per cent of the cotton is of the Acala variety, which is found most suited to California soil and climate. The actual yield per acre last year was 382 pounds for the state, with the San Joaquin lands going as high as a bale to the acre.

Milk Fat Comparisons

New York State Agricultural Experiment Station at Geneva, N. Y. has just published a bulletin (Technical Bulletin, No. 122) which is entitled "A Comparison of the Babcock, Gerber, and Roese-Gottlieb Methods for Determining the Percentage of Fat in Milk and Cream."

The recent introduction into this country of the Gerber test, as well as the occasionally expressed belief that the Babcock test gives results which are too high, prompted this study.

A total of 925 tests of milk and cream were made by the Roese-Gottlieb, Babcock, and Gerber methods in three different research laboratories and four dairy control laboratories.

It was soon recognized that, altho results by the Roese-Gottlieb method made at one laboratory agreed well with results of the same laboratory, they did not always agree so well with the results of another laboratory. In investigations which consider the accuracy of the Babcock or Gerber tests to percentages of less than 0.10, it is quite essential that the accuracy of the results by the Roese-Gottlieb method should also be studied.

The results of the study are given in the bulletin which may be obtained on request.

Exports of Vegetable Oils, Expressed, During January

Countries	Crude Pounds	Refined Pounds	Corn oil Pounds	Cocoa butter Pounds	Cocoa-nut oil Pounds	Linseed oil Pounds	Soy bean oil Pounds
Belgium		42,979					
Denmark & Fr. Is.		60,628					
France		213,504					
Germany		126,886					
Irish Free State		9,518					
Italy		24,122					
Netherlands		86,306					
Norway		458,966					
Sweden		204,688					
Switzerland		22,500					
United Kingdom		61,553					900
Canada	3,435,280	70,613	2,650	63,125	317,814	41,395	3,569
B. Honduras		80		156			
Costa Rica		1,708			13,600		2,700
Guatemala		6,429			1,236	5,114	3,275
Honduras		1,993				10,353	
Nicaragua		2,185			1,650	2,025	375
Panama	19,632	27,534		48		5,019	3,750
Salvador				192		1,500	
Mexico	182,020	150,339	96	356	546,505	5,794	26,250
Newfound. & Lab.						15,581	
Bermuda		87	46			284	
Barbados							450
Jamaica		18,880		62		70	5,400
Other B. W. In.		1,195	500		100	1,420	
Cuba		616,408		2,169	42,569	91,057	40,350
Dominican Rep.		4,210	6,450	35		5,883	3,115
D. W. Indies		24,440				75	3,975
F. W. Indies		31,521					
Haitian Rep.		6,781				5,698	4,687
Virgin Is. of U. S.		2,263	85				300
Argentina		355,967				4,297	
Brazil		798				4,095	
Chile	2,900	212,254				150	
Colombia		14,109		30	1,230	36,738	
Ecuador		320					5,880
D. Guiana		30,275					
Peru				308		375	
Uruguay		26,720					
Venezuela		724				13,679	
B. India							900
China		10,031				786	
Hongkong		485					
Japan, inc. Chosen.		89,993	25,500		3,763		
Philippine Is.		6,880				1,478	
B. Oceania						155	
F. Oceania		500				4,950	
N. Zealand		2,023			16,135		
B. E. Africa		1,925					
B. S. Africa		1,770					54,794
Liberia						750	
Canary Is.							7,650
Quantities	3,639,832	3,033,090	35,327	66,481	944,602	258,721	168,320
Total Values	249,676	298,256	4,874	28,128	84,735	31,917	22,504

Shipments from the United States to Non-Contiguous Territories

	Cottonseed		Linseed	
	Pounds	Dollars	Pounds	Dollars
Alaska	660	83	740	129
Hawaii	110,301	19,271	63,684	7,997
Porto Rico	15,557	1,600	118,516	14,074

January Exports of Oleo Oil, Tallow, Oleic Acid or Red Oil, and Other Animal Greases, Oils and Fats, N. E. S.

Countries	Oleo oil Pounds	Tallow Pounds	Oleic acid or red oil Pounds	Other animal greases, oils and fats, n.e.s. Pounds
Belgium	249,485	.....	.....	666,240
Denmark & Faroe Islands	235,918	.....	.....	60
Finland	23,084	.....	.....	.....
France	7,686	.....	.....	57,028
Germany	1,589,961	116,087	.....	135,530
Greece	625,500	2,245	.....	94,680
Irish Free State	28,423	.....	.....	.....
Italy	104,973	.....	.....	56,256
Netherlands	1,686,327	.....	.....	3,896,492
Norway	359,593	.....	.....	.....
Poland and Danzig	11,196	.....	.....	.....
Sweden	32,935	.....	.....	.....
Switzerland	46,514	.....	.....	.....
United Kingdom	1,043,155	43,057	.....	380,012
Canada	.....	60,147	50,030	442,889
Costa Rica	.....	.....	.....	25,200
Guatemala	.....	976	.....	57,709
Honduras	.....	820	.....	7,600
Nicaragua	.....	.....	.....	46,148
Salvador	.....	.....	.....	12,000
Mexico	10.805	69,999	46,716	225,204
Newfoundland & Labrador	152,697	.....	.....	.....
Barbados	.....	754	.....	.....
Jamaica	100	.....	.....	.....
Trinadad and Tobago	.....	406	.....	.....
Other British W. Indies	250	.....	.....	.....
Cuba	146,349	158	106	1,980,057
Dominican Republic	.....	161,730	.....	71,984
Haitian Republic	.....	1,000	.....	.....
Argentina	388	.....	.....	4,287
Bolivia	.....	.....	.....	267
Chile	.....	.....	.....	250
Colombia	7,663	44,722	3,868	74,936
Peru	.....	10,705	1,211	12,826
China	148	.....	.....	.....
Japan, including Chosen	7,905	6,714	.....	.....
Philippine Islands	.....	.....	.....	100
Syria	52,516	.....	.....	.....
French Oceania	.....	.....	.....	307
New Zealand	.....	.....	.....	82
British South Africa	.....	.....	.....	560
Egypt	11,537	.....	.....	.....
Quantities	6,435,108	524,520	101,931	8,248,704
Total values	655,303	45,527	9,049	725,156

Exports of Lard Compounds and Oleomargarine During January

Countries	Lard compounds containing animal fats		Oleomargarine of animal or vegetable fats		Vegetable oil lard compounds	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
Austria	8,400	840	.....	.....	.....	.....
Belgium	5,000	750	.....	.....	260	52
Netherlands	2,000	200	.....	.....	.....	.....
Norway	89,375	11,806	.....	.....	2,750	268
United Kingdom	540,143	61,519	.....	.....	.....	.....
Canada	1,255	211	.....	.....	2,055	460
British Honduras	4,287	479	60	12	8,182	803
Costa Rica	.....	.....	.....	.....	2,212	317
Guatemala	2,000	223	150	35	19,631	3,330
Honduras	900	118	.....	.....	8,129	1,401
Nicaragua	3,088	320	.....	.....	8,707	978
Panama	51,814	6,306	36,570	5,701	14,455	2,219
Mexico	29,287	3,441	3,524	674	179,825	18,919
Newfdld. & Labrador	8,301	830	.....	.....	2,031	266
Bermuda	1,936	326	240	53	8,606	1,365
Barbados	.....	.....	250	37	.....	.....
Jamaica	1,850	187	100	19	18,843	2,906
Other Brit. W. Indies	32,494	3,688	7,338	1,346	20,657	2,456
Cuba	729,377	73,357	2,000	560	138,339	16,121
Dominican Repub.	100	15	1,250	245	2,050	269
Dutch West Indies	33,900	4,944	.....	.....	600	84
French West Indies	400	48	.....	.....	.....	.....
Haitian Republic	93,110	13,192	2,725	620	16,000	2,268
Virgin Islands of U. S.	25,273	2,800	5,550	995	7,018	923
Chile	90,440	11,747	.....	.....	11,864	1,413
Colombia	.....	.....	112	27	358	71
Ecuador	.....	.....	.....	.....	25,000	3,500
British Guiana	.....	.....	500	75	.....	.....
Peru	6,000	840	.....	.....	64	17
Venezuela	325	36	.....	.....	4,181	787
British India	.....	.....	.....	.....	360	78
British Malaya	.....	.....	.....	.....	2,250	174
China	.....	.....	.....	.....	6,354	1,563
Hongkong	.....	.....	.....	.....	252	71
Japan, inc. Chosen	.....	.....	.....	.....	1,080	248
Philippine Islands	6,440	949	.....	.....	9,180	1,939
Syria	.....	.....	.....	.....	464	98
French Oceania	450	72	.....	.....	1,068	269
New Zealand	.....	.....	.....	.....	3,220	506
British W. Africa	10,508	1,541	.....	.....	2,199	252
Liberia	.....	.....	.....	.....	124	30
Other Portugese Afr.	.....	.....	.....	.....	764	146
Canary Islands	1,000	128	.....	.....	.....	.....
Total	1,779,453	200,913	60,369	10,399	529,132	66,567

Shipments from the United States to non-contiguous territories.

	Lard compounds containing animal fats	
	Pounds	Dollars
Alaska	3,571	524
Hawaii	189,876	25,521
Porto Rico	223,920	24,994

ABSTRACTS

Resistance of Fat-Soluble Vitamins to Hydrogenation. L. Randoin and R. Lecoq. (*Ann. Falsif.*, 1926, 19, 518-523.)—In order to hydrogenate cod liver oil satisfactorily on a semi-industrial scale with nickel catalyst a temperature of about 180-190° C. is necessary. Such hydrogenated oil (iodine value 28.7) was given to rats showing typical rachitic signs on a Sherman and Pappenheimer No. 84 diet, with the result that a slow rate of growth was maintained, but ophthalmic lesions were not always precluded. Hydrogen under pressure did not inhibit the destructive effect of heat on the fat-soluble vitamins. It was found that butter, and particularly summer butter, was not so wanting in antirachitic properties as has been thought, but margarines prepared with hydrogenated oils are inferior to those with natural oils and fats as sources of fat-soluble vitamins. D. G. H.

On the Growth-Promoting Property of Irradiated Fat in the Diet, of Direct Irradiation and of Cod Liver Oil. H. Goldblatt and A. R. Moritz. (*J. Biol. Chem.*, 1926, 71, 127-137.)—By two methods an attempt was made to compare the growth-promoting power of irradiated fat in the diet, of direct irradiation and of cod liver oil in order to determine whether irradiated fat in the diet can be used in growth-promotion experiments, as a substitute for direct irradiation of the animals. This would be an advantage in the case of small animals, for hooding of the eyes is troublesome and time-consuming, and direct irradiation otherwise induces a conjunctivitis and opacity of the cornea which complicates other eye changes induced by diet, and probably affects the general condition of the animals. Irradiated fat in the diet and direct irradiation possess, to about the same degree, the power to promote gain in weight of rats on a diet deficient in both fat-soluble vitamins (*A* and *D*), but this power is less than that of cod liver oil, which possesses the growth-promoting power to a far greater degree, since it is rich in vitamins *A* and *D*. Thus irradiated oil in the diet can be used in growth promotion experiments as a substitute for direct irradiation of animals, but neither source of radiant energy can act as a complete substitute for cod liver oil unless fat-soluble vitamin *A* is also administered. Radiant energy, administered directly or indirectly, although it prolongs and enhances growth, does not prolong the life of rats on a diet deficient in vitamins *A* and *D*, and does not prevent their developing xerophthalmia.

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Rate of Molecular Weight Increase in the Boiling of Linseed and Tung Oils.

Apparatus for Determining the Moisture in Soap by Distillation with Xylene.

Effects of Ultra Violet Light on Paint Vehicles.

Function of Oils and Fats and Emulsion of Oil and Water in Bread Making with Special Reference to Gluten Formation and Modification.

Patents

Refining and Deodorizing Oils and Fats. A. S. Quick (E.P. 261,440, 18.6.25).

Manufacture of Butter Fat Products (U.S.P. 1.605,108).